I UT Global Pte Ltd
Innovative Waste Management Technologies & Solutions

ISWA-WMRAS Technical Workshop 2010

Organic Waste Treatment Technologies

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CEO/Managing Director

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Introduction to IUT Group

- Singapore based Specialist provider of **leading sustainable waste treatment solutions**
- Use **Advanced European waste treatment technologies** to design, build and operate environmentally friendly integrated waste management solutions
- Implemented >80 waste treatment / sorting solutions globally
- **Further Plants** under development in various cities in **Asia Pacific** region incl USA
- Selective **Bio-technology** based R&D
  - Increase range of applications of technologies
  - Enhance efficiency and productivity of existing technologies
IUT Group Technology Capabilities

- Organic Waste Bio-Methanisation
- Landfill Rehabilitation & Engineering
- Landfill Gas to Energy Landfill Management
- Organic Waste Composting
- Constr / Demol Waste Material Recovery Facilities
- Soil & Groundwater Remediation
## Comparative Analysis of Treatment Technologies for Organic Waste

<table>
<thead>
<tr>
<th></th>
<th>Land Usage</th>
<th>Odours</th>
<th>Environmental Impact</th>
<th>Investment</th>
<th>Technical Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land Filling</strong></td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium / Low</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Composting</strong></td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Anaerobic Digestion (AD)</strong></td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Incineration</strong></td>
<td>Low</td>
<td>Low</td>
<td>Medium High</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>
# Various AD Systems

<table>
<thead>
<tr>
<th>Mesophilic</th>
<th>Thermophilic</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-40 °C (typical 35°C)</td>
<td>40-70 °C (typical 55°C)</td>
</tr>
<tr>
<td>Slower Reaction – Easier To Control</td>
<td>Faster Reaction – Continuous Monitoring</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low Solids (Wet)</th>
<th>High Solids (Dry)</th>
</tr>
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<tbody>
<tr>
<td>3%-15% dry solids</td>
<td>20%-40% dry solids</td>
</tr>
<tr>
<td>Mechanical or Gas Mixing System</td>
<td>Plug Flow System</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Single Stage</th>
<th>Dual Stage</th>
</tr>
</thead>
</table>
| Single Tank for Acidogenesis & Methanogenesis. | 1\textsuperscript{st} Tank optimised for Acidogenesis  
2\textsuperscript{nd} Tank optimised for Methanogenesis |
Bio-Methanisation Treatment Plant

Tuas
Singapore
Project Rationale - Government Focus on Waste Recycling

Total Solid Waste Generated Daily in Singapore
- Over 16,750 tons per day (tpd)
- Recycling rate at 57% (mainly paper/metal/construction waste)
- Hence, over 7,200 tpd of waste sent to incinerators for disposal
- After incineration, ash (approx 20% vol of waste incinerated) needs to be sent to a Landfill for final disposal

Food Waste Generated Daily in Singapore
- Over 1,660 tpd, increasing with Govt promotion of food industry and population growth
- Recycling rate at 13% (Singapore Green Plan 2012 target 30%)
- More than 1,400 tpd delivered to Incinerator
- Food waste has very high water content - unsuitable for incineration

Incineration - Unsustainable solution for Singapore
- Costly facility (Tuas South incinerator cost over S$900mil)
- Not a stand-alone solution - requires equally costly landfill (Pulau Semakau landfill costs over S$600 mil)
- Hence, Singapore Govt emphasize Recycling, especially wet food waste to defer need for new Incinerators and landfills
Rationale for Bio-Methanisation Plant in Singapore

Proposed up to 800 tpd Organic Waste Plant (Phase 1 - 300 tpd)

- Effective solution to recycle organics back to the environment (creates bio-compost)
- Significant increase in recycling rate
- Generates green electrical power
- Heat recovery for district heating / cooling systems
- Reduce greenhouse gas emissions
- Qualifies for CER certificates (carbon credits)
Singapore Waste Management Cycle - **UNSUSTAINABLE**

- **Food & Green Waste**
- **Incineration Plant**
- **Tuas Marine Transfer Station & Barge**
- **Incineration Ash**
- **Pulau Semakau Landfill**
CLOSING THE CARBON LOOP

Food & Green Waste

IUT Singapore Organic Waste Recycling Plant, Tuas

Singapore City in a Garden

Bio-Compost
Simplified Schematic Flow of Plant

Organic Waste → Screening & Shredding → Biological Digestion → Composting & Maturation

- Inorganic & Recyclables
- Renewable Energy (Electricity & Heat)
- Compost Organic Growth Media

Output: Bio-Gas
Multiple Streams of Revenue

- **Waste Treatment Fee**
  - Tipping of Organic Waste

- **Energy Generation**
  1) Electricity & Heat via Gas Engines and / or
  2) BioGas Sale
     - Industrial Boilers
     - Compressed Natural Gas

- **Bio-Compost Sale**
  - Alternative to Chemical Fertiliser
  - Agricultural & Landscaping Applications

- **Carbon Credits (CER)**
  - Mitigating Methane Emissions from Landfills
  - Displace Fossil Fuel based power generation
Tuas Plant Design Specifications
1st Phase (300 tons/day)

- Mixed Organic Waste: 300 tons /day
- Inorganics: 15%
- Digester Retention Time: 14-21 days
- Gas Yield: 130-150 cu.m/ton
- Volume Required for 21-Day Residence: 6,615 cu.m
- Total Digester Available Volume (2 pcs): 7,400 cu.m
- Total Solids: 8% - 12%
- Operating Temperature: 52-55 degC

- Pre-Treatment Running Hours: 14 Hours
- Digester Running Hours: 24 Hours
Tuas Plant Design Specifications (2)

**Power Generation & Consumption**
- Gas Engines
  - 2 x 1,063 kW
  - 1 x 1,500 kW
- Internal Consumption
  - 400 kW
- Power Export
  - 3,226 kW
- Running Hours
  - 24 hrs x 7 days

**Composting Complex**
- No of Composting Lines
  - 14 lines
- Composting turning frequency
  - 3 days
- Composting time
  - 39 days
- Compost Production
  - 50-55 tons/day
Bio-Methanisation Plant Process Flow

- Organic/Food Waste 300 tpd
  - Bag Breaker
  - Drum Screen
  - Metal Separator
  - Bio-Bunker
  - ADOS Mill

- Inorganic 45 tpd

- Gas Holder
  - Gas Blower
  - Flare

- Electricity 2-3.5MW
  - Gas Engine
  - Generator

- Digester
  - Heat Exchanger
  - Heat
  - Digested Material

- Recirculation Pumps
  - Circulate Material

- WWTP
  - Treated Water Effluent

- Dewatering Press
  - Circulate Material
  - Recirculation Pumps
  - Structure Material
  - Mixer
  - Composting
  - Compost 50-55 tpd

- Strictly Confidential
Further Integration Potential

**BioDiesel Facility**
- Harness waste heat from gas engine combustion
- Combined collection of food waste & waste oil

**Gasification System**
- Plastics from sorting process as feedstock for Gasifier
- Syn-Gas produced fed into Gas Engines for power generation
# AD Operational Considerations

## Odour Nuisance
- Entire system housed within complex with negative ambient pressure.
- All air treated via chemical scrubbers before release.

## Hygiene & Health
- Digester operating at 55degC and Composting at 60-70degC ensures pathogens eliminated and final compost safe for handling.
- All plant staff wear full protective gear when handling waste.

## Digester Stability
**Heterogenous Waste**
- Lab Analysis of new sources of waste before acceptance.
- Careful pre-mixing of feedstock necessary
- Large scale digester has internal buffer to absorb contamination in feedstock
National ENERGY GLOBE Overall Winner
Singapore 2008

Nominated by Energy Market Authority of S’pore to represent S’pore for the Asean Energy Award 2010
Thank YOU for Your Attention

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